Space Weather Technical Forecast

Issued on Friday 6 December 2024 at 00:30 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Low to Moderate activity. Slight chance G1 Minor Storms day 4 (09 Dec).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with three M-class flares, and peak flare M2.5 at 05/1040 UTC from over the southwest limb, likely AR3906. There are eight sunspot regions on the Earth-facing Sun, however these are generally small and simple. The most notable are potentially AR3916 and AR3917 in the southeast, as these appear brighter in GOES SUVI imagery, including 195 and 304. This is despite their relatively simple bipolar appearance.

No Earth-directed CMEs were observed, although a couple did occur off the Earth-Sun line, including from the M2.5 flare. There are also a number of filaments on the visible disc, including a large north-south feature in the southeast. These will need to be monitored for any potential lift-off.

Solar Wind / Geomagnetic Activity: Recent slightly elevated solar winds eased with mainly background slow wind conditions returning. Solar wind speeds were declined from 450 km/s to around or just below 400 km/s. Density also eased from near average to below. Total Interplanetary Magnetic Field (IMF), Bt, was weak at 5-8nT, while the north-south component was also weak between +/- 6nT, favouring a positive (northward) orientation. Phi angle was negative (towards the Sun) throughout. Geomagnetic activity was Quiet.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was at Background. The associated 24-hour fluence was below Active. The 06/0000UTC observation was 1.54e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with a chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Background winds and Quiet geomagnetic activity is expected until the arrival of the next coronal hole sourced fast wind, most likely either very late on day 3 or more likely on day 4 (08-09 Dec). Geomagnetic activity is likely to become Unsettled to Active with a slight chance of G1 Minor Storms.

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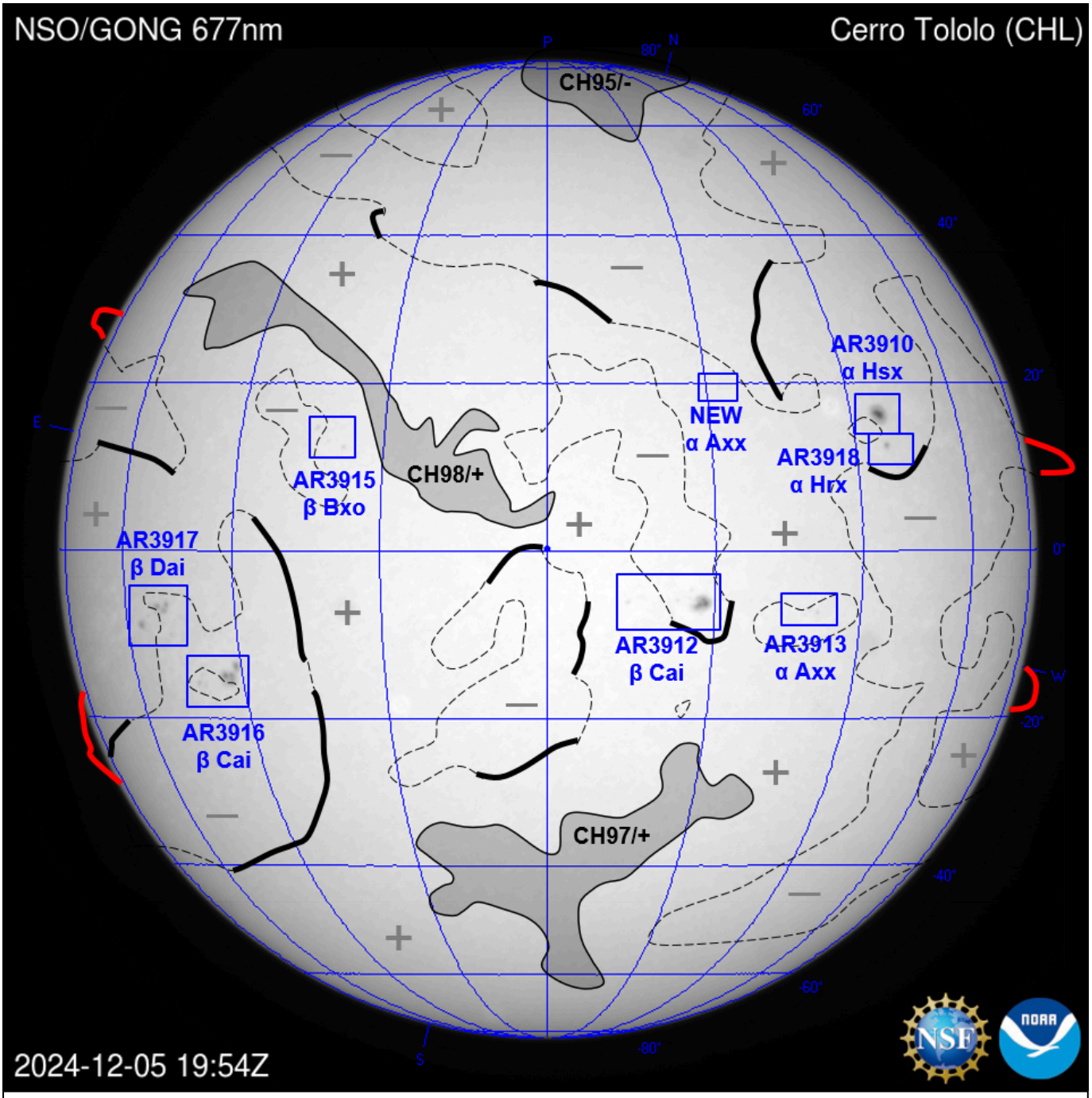
Energetic Particles / Solar Radiation: High energy protons are expected to persist at Background. High energy electron flux is expected to persist mainly at Background, with the associated 24 hour fluence remaining below the Active threshold.

Figure 1: MOSWOC Synoptic Map 05/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs.

Background solar winds are expected to continue through days 1-3 (06-08 Dec) with mainly Quiet geomagnetic activity. While MOSWOC Enlil has a weak connection to persistent CH97/+, this considered too far south to have a noticeable influence at Earth. This is supported by the previous rotation where no enhancement occurred despite the coronal hole being located further north.

Later on day 3 or more likely on day 4 (08-09 Dec) a connection to the fast wind from CH98/+ is likely to occur. Within MOSWOC Enlil, a connection to this feature is currently indicated to occur late on day2-3 (07-08 Dec), however this is considered likely too fast given the location of the features leading edge. Despite this, this does increase confidence for a reasonable connection to this feature later in the period. Confidence remains low for any notable geomagnetic activity however, as this is less favoured towards the solstices (Russell-McPherron effect).

Overall mainly Quiet conditions at first are expected to increase to Unsettled to Active with a slight chance of G1 Minor Storm intervals by the end of day 4 (09 Dec).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	1	1	5	20
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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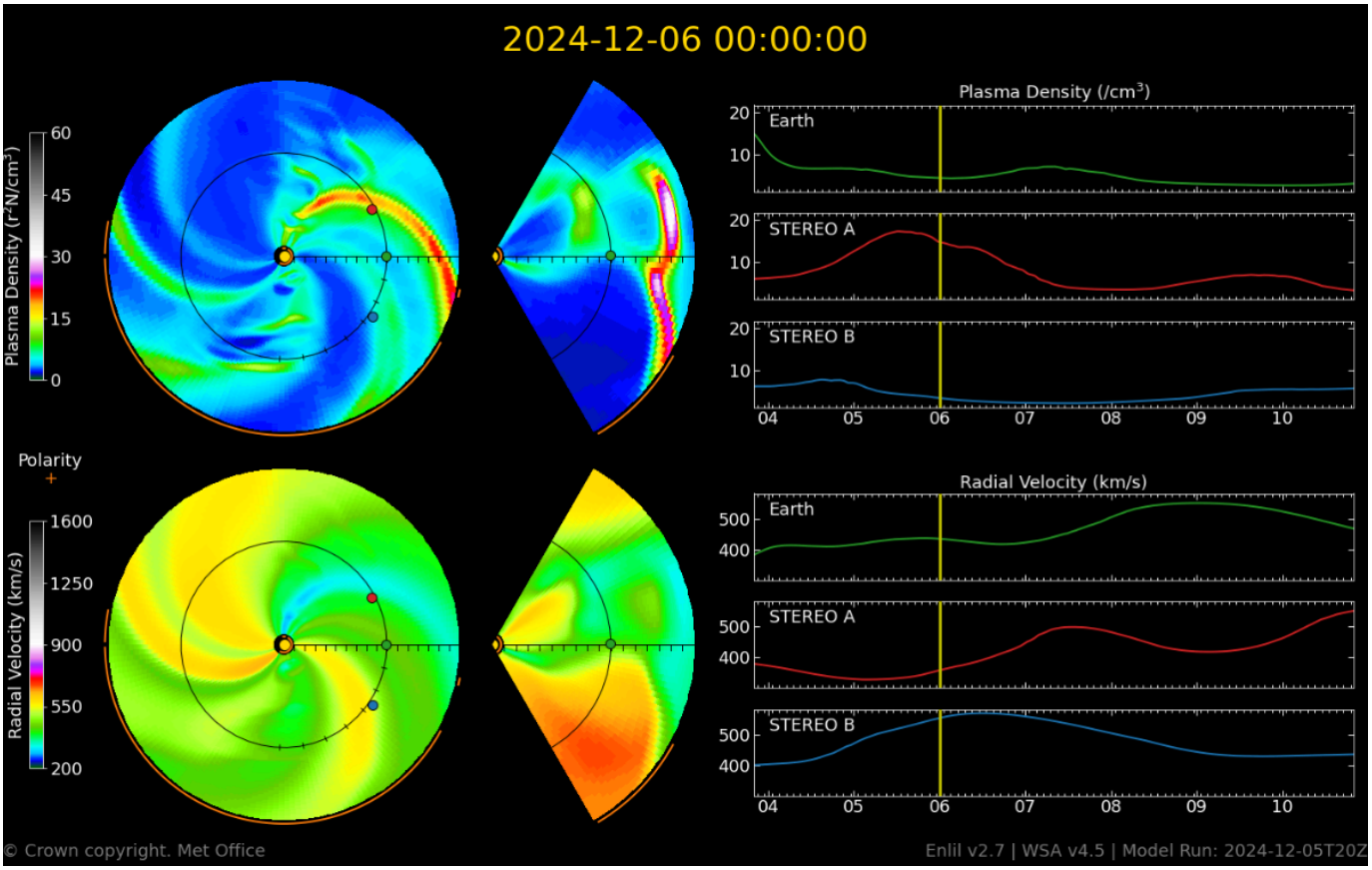
Figure 2: MOSWOC Enlil. Weak connection to CH97 shown, and not observed. Expected enhancement from 07 Dec from CH98 is too soon, most likely occurring 08-09 Dec.



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Radio Blackouts - X-Ray Flares

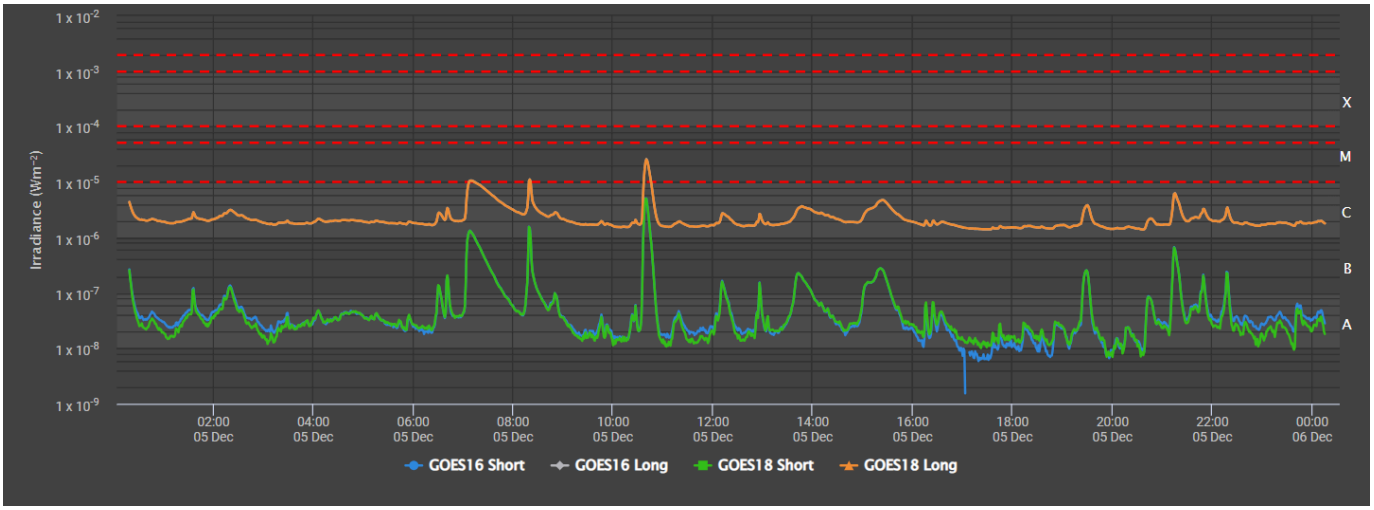
There are eight sunspot regions on the Earth-facing disc, with the largest and most complex of these AR3816 in the southeast. This is still a small and relatively simple group, with a main leader spot and only very small trailers. This is followed to the northeast by AR3817, which is a further small bipolar group. The only other region of note is likely AR3812 in the southeast, however this also remains straightforward, comprised of a main leader spot and only small and barely perceptible trailer spots.

Far-sided products remain bereft of any strong signals for returning groups from over the east limb, despite the potential for AR3904 and AR3898 to soon move back onto the disc. These may be related the bright magnetic loops evident just over the southeast limb in GOES SUVI 195, while a further bright cluster of loops is evident in the northeast. Both these areas could be sources of oncoming activity.

Low to Moderate activity is expected with only small and relatively simple active regions currently visible, and no notable ongoing development.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	50	50	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 3: GOES 16-18 X-ray Irradiance



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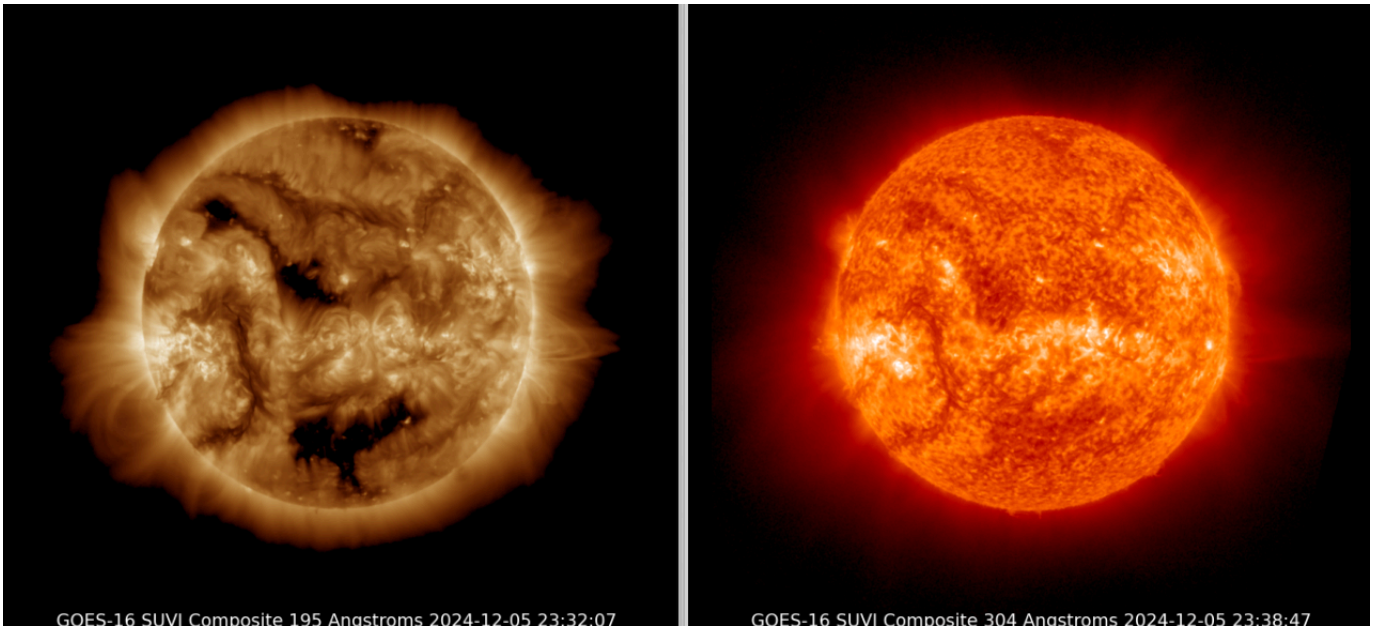
Solar Radiation Storms (High Energy Protons)

GOES18 proton flux is currently at background and expected to remain at this level with the sunspot regions on the Earth-facing disc currently small and relatively simple.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-16 SUVI images of current disc, showing main activity is in the east, with further potential activity coming around the limb.



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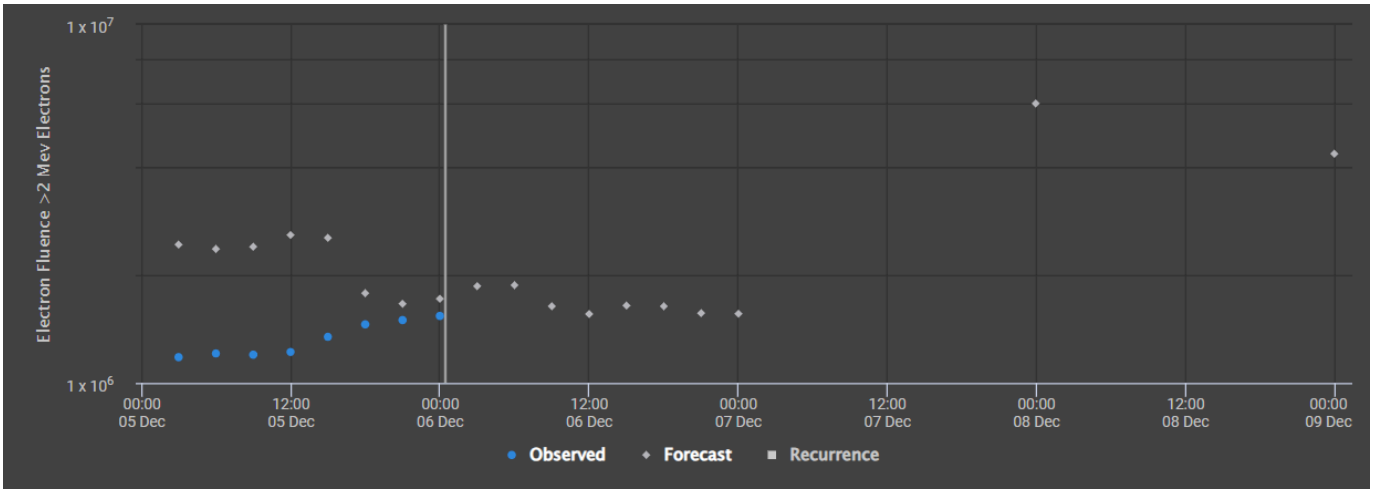
High Energy Electrons (≥ 2MeV)

High energy Electron flux observed by GOES16 is at Background. This is expected to persist, with no significant coronal hole or CME enhancements currently anticipated during the forecast period.

The associated 24-hour fluence is expected to persist below Active levels, with MOSWOC REFM currently considered to be providing good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 5: GOES 18 >2 MeV fluence with REFM.



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